

Electronic Government Systems Interoperability Model

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Abstract—Electronic Government (e-Government) is an initiative to transform the public-sector delivery system towards providing high-performance services and becoming more citizen-oriented. The emergence of broadband and communications technology has become the catalyst for the growth of online systems that form the main thrust of e-Government. However, the satisfaction level of e-Government systems among citizens is still low because of recurrent transactions in various isolated systems. This is due to the fact that most e-Government systems have yet to be integrated. Successful integration could only be achieved if interoperability factors are completely defined and introduced in the early stages of systems development. These requirements currently are not fulfilled. Previous studies have identified seven contributing factors towards e-Government systems interoperability. This study extends the findings further by confirming those factors through a qualitative approach. Semi-structured interviews were used involving five highly experienced informants from various Government agencies. The empirical data were then analysed using the content analysis method. From the analysis, the seven factors were refined into respective elements, which delineate the characteristics of each factor. The factors and elements then together form an e-Government systems interoperability model.

Index Terms—e-Government; Interoperability; Integrated Management System; Online Services.

I. INTRODUCTION

E-Government is an initiative to transform the Government's service delivery capitalizing upon the emergence of new Information Technology that will change the Government practices and services of this century [1]. According to Gartner, this initiative is recognised as a key strategic requirement to efficiently increase Government service with broader access, ease of use, and cost savings [2]. Nowadays, a growing trend has shifted the Government service paradigm from a people-centric model towards a more people-driven model. From this, inefficient processes and procedures have been reduced substantially, resulting in more efficient Government services for citizens and businesses [3]. Providing complete online services with an e-Government platform is essential for social inclusion and citizen participation. Citizens need to believe in the quality of the online services provided, and cultivate trust in the Government's responsiveness.

However, a major drawback concerning the implementation of an e-Government has been identified. Most agencies still practise isolated silos in Public administration, discouraging collaborative efforts among them [4]. Therefore, the people have to perform redundant procedures to complete online transactions. Taking these

issues into account, a more holistic approach needs to be introduced. According to UNDESA, Whole-of-Government (WoG) allows governments to pursue sustainable development more effectively via integrated service delivery [5]. This approach refers to the concept of a one-stop Government to drive transformations of existing administration from being based on typical bureaucracy to a more citizen-centered mechanism. Moreover, this provides cross-boundary collaboration that will solve complex issues among agencies. Hence, people can stay connected seamlessly via online services and recurrent transactions can be reduced.

Several studies have pointed out that institutional coordination and cross-boundary collaboration can be achieved by implementing interoperability from the early stages of system development [6], [7]. Previous research has found that interoperability is not merely a technical matter [1]. While technology certainly plays an important role, there are other non-technical factors that are instrumental to ensuring effective collaboration and service integration. Both factors must be considered in developing a one-stop-center Government service delivery [8]. Complete guidelines need to be established to promote effective collaborative governance through interoperability [9], [10].

In the previous study [10], an attempt has been made to review existing findings and outline key contributing factors concerning e-Government systems interoperability. This study extends the work further by proposing a model that aids in the shaping of interoperable e-Government systems. In particular, it confirms, refines and consolidates the factors as one holistic view through an empirical study.

This paper is organised as follows: the next section presents a literature review outlining the challenges facing the e-Government in the global context and examines the contributing factors towards successful e-Government interoperability. This is followed by Section 3, which presents a summary of the methods used to carry out the study discussed in this paper. Section 4 then outlines the analysis of empirical work. Section 5 explains the proposed e-Government interoperability model and outlines the potential future work.

II. LITERATURE REVIEW

Successful e-Government implementation embraces industry revolution, bringing great promise for future innovations and positive impacts on citizens and businesses. These initiatives have increased Government transparency and accountability in delivering services to the society that could drive longer-term growth [11]. In addition, higher

demands from citizens and business towards online services have emphasized the importance of an e-Government. Therefore, information and systems must always be available online, giving more opportunity to the Public to deal with their business with the Government [12]. Moreover, in order to establish services that are tailor-made to the citizen and business needs, it is required that effective collaboration and strategic framework following the Government business reference model be provided [13], [14]. More specifically, an integrated e-Government framework is needed to deliver heterogeneous online Public Services to the Public [4].

Previous studies have found that interoperability adoption involves more than just an understanding of technological aspects [15]. From the theoretical research, seven factors were identified consisting of technical and non-technical aspects. The human factor has been found to impact the success of interoperability strategy in organizations [16]. This includes involvement from the top-management level to the ground-level in organizations with their specific roles to facilitate the implementation of interoperability. A few studies have highlighted the main benefits for the people involved in the strategic planning and execution phase of interoperability. These include the Chief Information Officer (CIO) that is responsible in realizing the e-Government vision towards a more citizen-centric service transformation [17]. Furthermore, commitment towards the implementation of interoperability is shown via the provision of a clear direction to all employees and support for these initiatives together with the appropriate resources.

According to UNDESA, the CIO role and authority will help towards developing a more integrated management of e-Government [5]. Meanwhile, the CIO and authorities could use their political position to improve coordination and cooperation across Government agencies. Other roles that are equally important in the interoperability development encompass the policy makers, legal advisors, domain experts, IT managers, IT officers, as well as quality auditors. From the empirical evidence in the available literature, these roles are highly significant in an organization and should be incorporated from the initial stages of developing a service [16]. Moreover, the potential for realizing the Government transformation agenda is highly dependent on the working collaboration between all parties in an organization and across agencies [18].

Promoting an effective e-Government and interoperability requires strong political commitment towards a holistic institutional framework. In fact, this will shape the working environment and human resource management of an organization [19]. In some situations, political will is required to solve interoperability issues across Ministries and agencies, mainly involving policies and legal matters [1]. Therefore, Government institutions should follow national strategic ICT planning in order to address this issue. Integrated e-Government services may increasingly support policy integration and encourage Government institutions to work more closely [5]. In India, for example, e-Government initiatives were published via integrated service delivery with a set of core policies and infrastructure facilities [7]. This is a vital means for a successful delivery of e-Government services there. Together with these efforts, more attention and support needs to be established among government institutions including development of organizational cultures, coordination mechanisms, and financial as well as accountable online services.

E-Government interoperability requires institutional coordination and collaboration across agencies. Hence, any policy related to e-Government implementations must be aligned with Malaysia's digital transformation agenda, which is to provide integrated services in a one-stop access portal [20]. This includes inter-linkage and policy integration across different domains and Ministries. Policy integration efforts cut across the boundaries between vertical tiers of policy-making, from higher institutions, to the State and local authorities [5]. It is designed for better coordination of Government initiatives and aligns with the nation-wide e-Government strategy. It also requires collaboration between every party to provide the right information with similar understanding [1]. In addition, services will become more visible when dealing with interlinked policy domains. According to the UN E-Gov Survey 2016 report, ICT-based governance and policy modeling tools can be used to increase citizen and business participation in online services [5]. These tools can help the Government to design services that are tailor-made for citizen and business needs.

Another challenge in interoperability implementation includes issues related to legal frameworks. Many governments have implemented legislation on the right to access government information. However, this only implicates open government data and Public information. In some cases, interoperability involves restricted data that have legal barriers to access and exchange to other parties. This issue can be resolved through improvements of legal and regulatory frameworks [21]. Moreover, this solution could also enhance cooperation across Ministries. Therefore, each government has to develop its own strategy and identify the legal requirements to meet the challenges of e-Government development. In order to increase cooperation, it is important to achieve mutually agreed e-Government goals among different Ministries. This agreement must be presented at the organizational interoperability level, which will include a guideline on how collaboration and synchronization of Ministry business processes can be firmed up to deliver integrated e-Government services [1]. In the meantime, three tools are required in order to align organizational strategy, consisting of business process alignment, gap analysis and business process reengineering [22].

Standards are one of the important factors in technical interoperability implementation and should be aligned with national e-Government transformation goals [21]. Basically, standards cover technical and non-technical areas [15]. In the technical implementation phase, the main objective is to ensure that data can be successfully exchanged across agencies. In order to achieve this, both parties must understand the type of services, and their relationship and dependencies. In addition, all data elements must be associated with services and standards based on open data systems to facilitate the integration process [7]. From the technical perspective, this describes how technology supports the delivery of service components and relevant standards for implementing interoperability, convergence, and interconnectivity in order to work [23]. This will include a middleware solution for managing interoperability in organizations.

III. METHODOLOGY

The main objective of this study is to gather the contributing factors of successful e-Government systems

interoperability from both theoretical and empirical perspectives. The literature review has provided some insights into e-Government interoperability and the requirements of an integrated platform in modern e-Government systems, which have been reported partly in [10]. By exploring further empirically, this study aims to answer the following research questions (RQs):

RQ1: What are the factors that contribute towards successful e-Government system interoperability?

RQ2: How can these factors be merged as an e-Government system interoperability model?

For the theoretical part, several queries were performed from multiple databases such as Scopus and Web of Science as well as e-journal repositories such as IEEE Xplore, ACM Digital Library, Springer, Science Direct, Emerald, and Cambridge Books Online. The search keywords such as “interoperability”, “e-Government interoperability”, “e-Government interoperability framework”, “interoperability framework”, “integrated platform”, and “e-Government” or “interoperability” were used for the paper selection. In addition, other references including books, journals, proceedings, and reports were also reviewed in order to maintain a chain of evidence. The gathered data were examined and interpreted using content analysis. This produced some insights into the factors that impact integrated e-Government service delivery. These processes were carried out continuously throughout the study to gather the common factors that ensure successful e-Government systems interoperability. As a result, seven factors were identified consisting of people, politics, policy, legal, organization, standards, and technical specification.

The study continued with the empirical phase. In this stage, several interviews were conducted with informants from several agencies and backgrounds in order to validate the theoretical results. The informants were selected based on their experience with e-Government projects as well as their

roles in their organizations. Table 1 displays the information about the selected informants for this study. Based on the theoretical findings, a set interview questions were developed.

Table 2 summarises the interview questions used in the study. To ensure reliability and validity of these questions, a pilot study was conducted in a focus group session [24]. The refined version was finally published as an instrument. Next, the instrument was used in real interview sessions with informants. Before starting the interviews, the informants were first introduced to the interview protocol. This is important to make them understand the purpose of this research and to clarify any questions they might have. A semi-structured and open-ended questionnaire was designed based on the theoretical findings. The interview sessions began with a brief introduction about e-Government adoption and the future requirements for an integrated online services platform. The responses and comments were recorded during approximately two hours of conversation.

The interview data were gathered and analysed using the content analysis technique. The responses were segmented according to significant factors, existence, frequency and relationship between keywords. In order to clarify the responses and reach a true logical conclusion, inductive and deductive reasoning were used. The deductive reasoning was originated from the factors identified in the theoretical study. Meanwhile, the inductive reasoning was performed to identify new ideas from informants in the empirical study. These ideas were grouped into factors or elements. The processes were carried out continuously by using triangulation approach between the results and the insights collected from the literature [8]. At the end of both studies, a model was drafted. The model combines the contributing factors that ensure successful e-Government systems interoperability.

Table 1
Informants' Profiles

Sector	Agency	Informant Code	Position	Business Domain	Experience (Year)
Government	Federal	Informant 1	Asistant Principle Director	System Development	20
Government	Federal	Informant 2	Asistant Principle Director	System Development	20
Government	Statutory Body	Informant 3	IT Manager	Strategic Management	20
Government	Statutory Body	Informant 4	Asistant Principle Director	Networking & Secutiry	20
Government	Federal	Informant 5	IT Manager	Strategic Management	20

Table 2
Interview Questions

Factor	Description
People	To verify the important roles of each element and its responsibilities in the organization in order to achieve success in the interoperability initiative.
Politics	To confirm and validate the way in which politics is a significant factor in the strategic planning phase, and to determine the relationship between politics and policy integration as well as the legal factor.
Policy	To confirm and examine how policy can influence the entire organization, what policy is required in order to form inter-agency collaboration and what the relationship is between policies and other factors.
Legal	To confirm and examine how legal matters can influence the entire organization, what are the common issues regarding legal matters, and how to overcome these issues.
Organization	To confirm and validate the elements required for establishing organizational interoperability, how collaboration can be established among agencies to increase efficiency, and how to reduce bureaucracy in services.
Standards	To confirm and validate how standards are important in interoperability implementation. To identify the impact of having interoperability standards and how these can facilitate the data sharing process across heterogeneous sources.
Technical Specifications	To confirm and validate technical specifications to enable data exchange.

IV. RESULTS

The results are presented in three sub-sections. First, the people factor pertaining to their roles and responsible is

discussed. Then, the strategic planning phase consisting of politics, policy, and legal factors, and the third implementation phase consisting of organization, standards, and technical specification factors, are outlined. As

mentioned in the previous chapter, these factors were derived from the theoretical study and confirmed via the empirical study. From the interviews, all factors were accepted and no emergent factor was found. The following paragraphs present selected excerpts or quotes from the informants. Elements that were identified from each factor are marked in bold.

A. People

The analysis shows that the informants agreed that the people factor has a significant relationship with e-Government system interoperability. Six elements were identified in the human factors based on the empirical study, which are Chief Information Officer (CIO), Policy Maker, Legal Advisor, Domain Representative, Information Technology Manager, and Information Technology Officer. The role and function of each element are described in the next paragraphs.

The Chief Information Officer (CIO) must play a significant role to ensure the success of interoperability initiatives. Typically, an organization policy is dependent on the vision and aspirations of the CIO. – Informant 1

In some situations, this initiative (interoperability) could fail due to the policy constraints in an agency. Accordingly, the role of policy makers in reviewing existing policies and making sure they are in line with current need is paramount. – Informant 1

Since integration has been a requirement in previous e-Government projects, this factor must therefore be addressed in the early stages of interoperability implementation. Thereby, legal advisors should always evaluate Acts and Laws that relate to this initiative from time to time. – Informant 1

It is essential to engage with the domain representative from relevant sector services to ensure this initiative is in line with organization goals. – Informant 1

Coinciding with the Government's intention to create integrated Public Services, planning and ICT development should take into account the needs of system integration with other agencies. Thus, the Information Technology manager should be responsible for ensuring that the development of an ICT Strategic Plan is in line with the vision and mission of the organization. – Informant 1

Information Technology officers should have specific skills that cover various aspects of ICT such as system development, network, security, and database. These are the fundamental knowledge required for the implementation of this initiative (interoperability) at the technical level. – Informant 1

As influential individuals in the organization, the voice and insights of the CIO is essential to the development of the organization and improvement of quality of service. – Informant 2

Policy makers need to be sensitive to the needs of outside organizations, especially involving initiatives at the national level. This is to ensure the direction the organization is moving is in tandem with the Government. – Informant 2

I agree that the legal advisor must perform a revaluation of existing Laws to overcome the constraints of the legal aspects in interoperability implementation. – Informant 2

There is a need for continued cooperation between the Information Technology manager and Domain representative to ensure the right decisions are taken and agreed upon before an action is executed – Informant 2

The CIO serves as a liaison between the organization and the management of Information Technology. By understanding that business needs must be in line with technological knowledge, better decision-making can be achieved in organizations. – Informant 3

Policy makers have the voice to influence policy decisions in e-Government projects. Moreover, with fundamental knowledge in online services and integration in the Public Sector, decisions can be made more accurately, especially involving investment and allocation of development funds. – Informant 3

The legal advisor should ensure that existing Laws and policies are in line with the policy of an organization. – Informant 3

The Domain representative may provide input and suggestions regarding projects and initiatives to be implemented. With specialized knowledge in a particular area of service, the cooperation of the Domain representative is essential to ensuring that this initiative goes smoothly. – Informant 3

Among the responsibilities of the Information Technology manager is to ensure the planning and development of the ICT organization meets the national agenda, as mentioned in the Public Sector Information Technology Strategic Plan. – Informant 3

The Information Technology Officer should always explore new technology in accordance with the current ICT environment. For example, nowadays, consumers are more comfortable accessing information via mobile devices. Accordingly, the use of technological innovations is necessary for Government to become closer to users. Furthermore, the emergence of mobile and interoperability will help content dissemination across heterogeneous platforms. – Informant 3

The CIO must adopt a culture that is closer to the ground with his subordinates. This is to ensure a closer relationship could be established and to facilitate the initiative to be implemented in the future. – Informant 4

The Information Technology manager acts as a facilitator for resolving issues related to the interoperability implementation in their organization and cross-agency collaboration. – Informant 4

The Information Technology Officer needs to understand the needs of management and users of the system to ensure the implementation of interoperability can be carried out smoothly. – Informant 4

As the parties that have specialized knowledge in a particular area of service, the cooperation of Domain representatives is required to ensure that this initiative (interoperability) goes smoothly. – Informant 5

Interoperability requires strong commitment and the proper set up of a specialized team. Thus, the Information Technology manager needs to ensure continuous monitoring of progress including project coordination and technical works. – Informant 5

Technical skills are required in the interoperability implementation phase. Therefore, the Information Technology officer must obtain a clearer picture and confirm the supported technology that may be adopted to realize it. – Informant 5

B. Strategic Planning

Strategic planning is an organizational management activity. According to the Balanced Scorecard Institute, it is

used to set priorities and strengthen operations in an organization [25]. In addition, strategic planning activities are also essential to ensure that stakeholders are working toward common goals with priority given to increasing resources to ensure that the main goal of the organization is achieved with the involvement and cooperation of all parties. This framework specifies the elements of strategic planning that contribute to e-Government system interoperability. Based on the empirical study, three factors were identified, namely politics, policy, and legal, all of which will be described in the next sub-sections.

1) *Politics*

Power and political influence are necessary for successful planning and interoperability implementation. Political participation involves individuals or parties who have authority in an organization. They will determine policy decisions regarding the direction and strategy of the organization. Below are the feedbacks from the informants regarding the political factor:

Interoperability initiatives should begin from the top of the organization that have more authority and political influence as well as in the Public Sector institution. Political will determines the direction and goals of the organization in this initiative. – Informant 1

Generally, e-Government projects start from the top management direction. This includes efforts to establish cross-agency collaboration between heterogeneous e-Government systems. Therefore, organizations must have political will to set the direction and coordination between agencies. – Informant 2

The establishment of an ICT policy must be guided from top management direction, which has more political influence in the organization. This must be aligned with organizational core business and services. – Informant 3

Heads of Department that have political influence in their department plays an important role in this initiative. Their responsibilities include organizing, managing, and allocating development funds. – Informant 4

2) *Policy*

The informants believed that good policy will make administration easier, and would also allow people to get on with the organization's core business more efficiently and effectively. Below are the responses of the informants:

Policies should be formulated clearly and understood by every level of the organization. These must contain the procedures and guidelines on e-Government system management and technical aspects of interoperability in accordance with the vision and mission of the organization. In addition, policies should be developed with the consideration of the future needs of the system and their ability to integrate with other systems. – Informant 1

Organization policy must be in line with the current needs of the Public Sector. In fact, there are existing policies that are in line with inter-agency collaboration. Therefore, these policies should be reviewed and adjusted, particularly the ones that involve services at various levels. – Informant 2

Policy review must be taken into account if organization strategy does not comply with current Public Sector requirements. This involves the integration process between e-Government systems. In addition, continuous performance monitoring is important to ensure the successful implementation of this initiative. – Informant 3

Specific policies regarding the integration system should be developed at the national level by defining the interoperability element. This policy should adhere to and become a fundamental resource in the organization's internal policy development. – Informant 5

3) *Legal*

This factor must be clarified before the development and implementation phases. According to the informants, legal binds always become an obstacle in any interoperability initiative. The responses of the informants are listed below:

Typically, system integration fails due to factors involving legal processes and procedures of the agency. This issue takes a long time to resolve. In other cases, there are times when the system has been fully developed but is unable to integrate due to this issue. – Informant 1

Some agencies are bound to private and confidential information. In addition, current laws prevent this data from being shared directly through the system in order to preserve data security and confidentiality. Therefore, the Government should address this issue by implementing Acts such as the Personal Data Protection Act. – Informant 2

The management needs to review the factors constraining legislative efforts towards the integration of the system. – Informant 3

The current legislation that hinders the implementation of interoperability needs to be revised for the benefit and satisfaction of the people that use Government services. – Informant 4

C. *Implementation*

Implementation is a phase of transforming something from concept to reality. At this stage, activities involved in the strategic planning phase will be realized. Analysis of the study found that implementation of interoperability is composed of three factors including organization, standards, and technical specifications. Further details regarding the processes and relationships of each of these factors are described in the next sub-sections.

1) *Organization*

In the implementation phase, the main challenge is to form organizational collaboration between various agencies. Therefore, cooperation is needed to establish interoperability at the enterprise level. This will include the approval process to support data transition between agencies. The analysis shows that each informant agreed that consolidation at the enterprise level would result in agency cooperation. Below are the feedbacks regarding this factor:

We need to establish organization interoperability among agencies in order to understand the process and procedures of their work and vice versa. By the way, it is essential to set a clear direction for all agencies and continuously promote this initiative. Thus, collaboration can be easily implemented. – Informant 1

Interoperability initiatives require strong commitment from every agency. This is key to organizational collaboration and process improvements. In addition, it will also require business process alignment as well as top management support. Common approaches should be reviewed in order to prevent duplications in process or procedure. – Informant 2

Smart partnerships are one of the methods to enable the sharing of resources and information. It can also become the

basis for the establishment of interoperability in an organization. – Informant 3

Agencies should focus on organization core services while increasing efforts towards collaboration in order to deliver integrated services. The idea of a good organization is needed to realize this. – Informant 4

Based on the analysis, the informants agreed that cooperation should be established at the organizational level. This forms the basis for achieving process agreement in interoperability implementation. Cooperation can be established through performing business alignment via gap analysis and processing of re-engineering methods. The next step is to define Service-Level Agreements in order to establish the availability and performance goals for an application. In the last step, organizations must adopt a Change Management approach to ensure that the changes are acceptable.

Process alignment is required to map business processes and provide agencies with principles, policies, tools, and standards and guidelines for working together. These would act as a guide for the agency to develop a framework of services that support interoperability. – Informant 1

Business process interoperability provides a view for identifying areas of commonality and opportunities for integration or collaboration within an agency and between other agencies. This must be aligned with interoperability goals and guided by the wishes of the people who are looking for better Government services that are more effective and comprehensive. – Informant 2

Each agency must understand the work processes of other agencies to facilitate communication and collaboration in the sharing of resources and information. – Informant 3

Alignment of processes and procedures are necessary to ensure collaboration between agencies. This encompasses understanding of the connections that exist between agencies and their degree of commonality. Thus, information can be exchanged with more efficiency and speed. – Informant 4

From the analysis, the informants believed that business process alignment is required for connecting business strategy to achieve an agreed interoperability goal. Furthermore, the quality of existing processes and procedures will be improved, particularly when non-uniform processes and duplication of functions between agencies are involved. In some situations, requirements have not been clearly identified and addressed in an organization. Thus, brainstorming and gap analysis are needed to achieve interoperability objectives. The next paragraphs depict the views of the informants:

I understand that it's not an easy task to get agency commitment to implement interoperability. Some agencies are bound to Acts, legal constraints, and policies that are not in line with interoperability objectives. Therefore, I believe that with proper analysis, real issues can be resolved. – Informant 1

As a frontline Government agency, we have received lots of requests from stakeholders to integrate with our online services. However, we believe integration is more than just technical matters. Stakeholders need to understand our organization and services and what have been implemented. This can be done through the gap analysis method. – Informant 2

We need to measure branch performance to ensure they will meet our requirements in order to deliver up-to-date services throughout the country. This also includes

collaboration with other agencies with more convenient and hassle-free services. – Informant 3

Most informants stated that the gap analysis method can be used to measure agency performance and to identify the real issues related to interoperability implementation. After identifying the gaps, the next process will be to redesign services. Business process re-engineering can be used to analyse and design the workflows and business process within an organization. According to Gartner, this includes management policies, procedures and modeling, analysis, and design and testing techniques for analyzing existing business processes and systems [26]. Theoretical data also prove that this method could increase Public Sector performance and is also aligned with the national transformation agenda [27]. The informants also supported this argument. Below are their respective feedbacks:

We have received complaints about redundant Government services. According to the users, they need to complete recurrent processes and transactions from different agencies. Talking about a connected Government strategy, all systems must be ready and able to integrate. Therefore, current organizations, management, policies, and online services should be reviewed. I believe that with business process re-engineering this can be done. – Informant 1

We can increase our performance and client satisfaction by delivering the services that they need, with less hassle. We also need to speed up the verification process and reduce people effort to complete online forms. However, in some cases, there are policies and procedures that hinder us from achieving our objective. These needs to be reviewed. – Informant 2

Our direction must be aligned with the national agenda. If there is a need to establish an integrated e-Government platform at the national level, then we have to follow this to a T. We also understand the benefits of having this platform. Therefore, from our side, we need to start with business process re-engineering in order to meet this objective. – Informant 4

Besides the analysis and process improvements, agencies must determine the area for which collaboration should be established. This is an official commitment that prevails between agencies, also known as Service-Level Agreement. From this contract, both parties, either the service provider or subscriber will agree on the service contract including quality, availability, and responsibility before interoperability is accepted. The informants also agreed that this contract must be determined to protect the quality of services of both parties. Below are the feedbacks of the informants:

The Service-Level Agreement shows agency commitment in the interoperability initiative. In interoperability, the most important aspect is how to obtain and use data. Both parties must agree on this. – Informant 1

Our policy is to ensure that data will be protected from any unintended disclosure. The Service-Level Agreement gives us more confidence that the data will always be trusted, accurate, and relevant. Thus, this will create accountability on both sides. – Informant 3

We can get more clarity about services that are delivered through the Service-Level Agreement. This will make the interoperability process much easier, especially when heterogeneous systems from nation-wide agencies are involved. – Informant 5

The last element in organizational interoperability is to

adapt to changes. This can be done through the change management approach. Change Management provides a structured approach on how organizations can prepare, equip, and support changes. Interoperability will involve individual, organizational, and enterprise levels that provide competitive differentiation and the ability to effectively adapt to these changes [27], [28]. The informants also agreed that change management is essential to achieving the interoperability objective and involves commitments from the top to bottom of an organization. Below are the feedbacks of the informants:

Interoperability requires strong commitment from all levels in and outside an organization. We need to break the perspective of working in silos to achieve interoperability objective. Change Management must be adopted at every level of the organization to ensure we communicate our success and future progress. – Informant 1

I agree that Change Management is an essential element in organizational interoperability. Changes should start from the top, with a committed team advocated by the leader followed by employees at every level early on. – Informant 2

Change Management is necessary to gain interoperability acceptance. In a global environment and with increasingly diverse stakeholders, change will involve people, process, and technology. All elements must be considered to mitigate adverse impacts resulting from significant change. – Informant 5

2) Standards

In interoperability, standards are needed to exchange data. Standards must be agreed and adhered to by stakeholders in order to support data exchange [22]. As mentioned in the theoretical findings, standards may exist in technical standard and data standard. However, to enable technical exchange of data between systems, data standards play a crucial role. Data standards ensure that both parties have understood the data that is being transferred. This argument is also supported by the empirical data in this study. According to the informants, standards must be established at the national level, or by the organization that has more power to make decisions. Standards provide guidelines to the agency in order to pursue interoperability. The next paragraph depicts the views of the informants:

We need to comply with interoperability standards in order to enable data exchange across agencies. – Informant 1

Our system has provided a web service infrastructure to advocate data exchange. However, there are situations where interoperability was unsuccessfully implemented due to a discrepancy in standards. Therefore, interoperability standards need to be established at the national level and endorsed by the stakeholders. – Informant 2

We can use standards as our guideline as well as capitalize on our stakeholders to implement interoperability. These must be open so that data transfer can be done perfectly regardless of whether the data is from different sources and/or fraught with technical constraints. – Informant 5.

3) Technical Specifications

Technical specifications define the technical and operational standards, which stakeholders must comply with in order to enable technical interoperability [29]. The specification covers technical issues of linking computer

systems and services including data integration and middleware, security services, data presentation and exchange, network and accessibility as well as the system architecture. The informants agreed that technical compliance is key to technical interoperability. In this level, the objective is to ensure data can be transferred from the service provider to the subscriber. Below are the comments of the informants regarding this factor:

In order to exchange data, both parties must comply with the technical requirements for interoperability including data presentation, data type and metadata, communication protocol, application, and network infrastructure, as well as security. These requirements must be determined in setting the technical specifications. From there, we will know what data can be exchanged and how the transaction can be done. – Informant 1

We cannot compromise on data secrecy and security issues. Thus, both elements must be determined in the technical specifications. With this, data can be transmitted to diverse stakeholders without hesitation. – Informant 2

We have developed our own platform to connect with our agencies. From there, we can exchange data, information, and reports simultaneously with more privilege. This is how we started implementing interoperability. – Informant 3

Nowadays, demand for mobile services has slightly increased. Therefore, we need to provide a mobile channel instead of web applications to deliver our services. Updating information in both sources is a hassle. We don't want to do recurrent processes; thus we need interoperability as a middleware. – Informant 4

All Government data should be consolidated in an integrated database platform. We can reduce bureaucracy in services and eliminate the requesting of similar information from citizens. In addition, an integrated database platform supported by data interchange functions can make the system development process more scalable and interoperable. – Informant 5

V. DISCUSSION AND FUTURE WORK

The main objective of this study is to consolidate the factors that contribute towards the success of e-Government system interoperability in one view. Seven contributing factors were identified from both theoretical and empirical studies. The main aspect is the determination of the human factor in the strategic and implementation phase. The study identifies six roles in an organization that are responsible for the interoperability initiative. The roles include Chief Information Officer, Policy Maker, Legal Advisor, Domain Representative, IT Manager, and IT Officer. In general, managerial practices should be simultaneous and fully aligned with organizational objectives. The objectives should be in line with and adapted by every level of the organization—from top to bottom. A higher commitment from the top management will result in the betterment of the whole organization.

From the Strategic Planning perspective, three factors are required in order to successfully implement interoperability. These factors include politics, policy and legal matters. The interoperability initiative involves collaboration from a higher authority and is strongly influenced by political leadership. The politics determines the vision and mission of an organization. This includes the formation of a roadmap for inter-agency collaboration in order to facilitate

organizational changes towards this initiative. Besides politics, strategic interoperability planning entails considering organization engagement among different areas of policy and legislation. All parties must share a mutual understanding and be in line with the national strategies and this requires the breaking down of silos between Public Sector agencies. Implementing integrated policy-making and legal issues however are often the toughest challenges towards achieving interoperability.

In the implementation phase, three factors are crucial including organization, standards and technical specifications. Collaboration at the enterprise level would result in agency cooperation. There are four main elements for organization interoperability. The elements encompass business process alignment, gap analysis, business process re-engineering and change management. These elements are essential for enhancing process coordination and reducing bureaucracy in services. Meanwhile, standardization is needed to incorporate data from heterogeneous e-Government systems. Standards provide an abstract view of services that can be used to develop generic solutions applicable in various service domains. Standards need to be flexible so that even diverse stakeholders and other business

lines can understand them to maximize e-Government service transformation.

The ultimate objective for interoperability is to enable data exchange across multiple platforms. Therefore, at this level, interoperability is highly dependent on technical specifications. The technical specifications provide minimum requirements for technical aspects that need to be advocated by agencies. Five key elements of technical specifications consisting of data presentation, communication protocol, application infrastructure, network infrastructure, and security to support the data exchange process. The fulfillment of these requirements shows the agency's readiness to adopt interoperability.

Figure 1 depicts the e-Government system interoperability model. This model provides an overview towards the creation of efficient and high revenue streams in Public Service delivery through interoperable e-Government systems. The model could be used for designing a comprehensive e-Government interoperability framework in the future. In fact, each actor has its own critical elements that are worth investigated in specific. Future work could explore further how these elements should be operationalised to support the interoperability objectives.

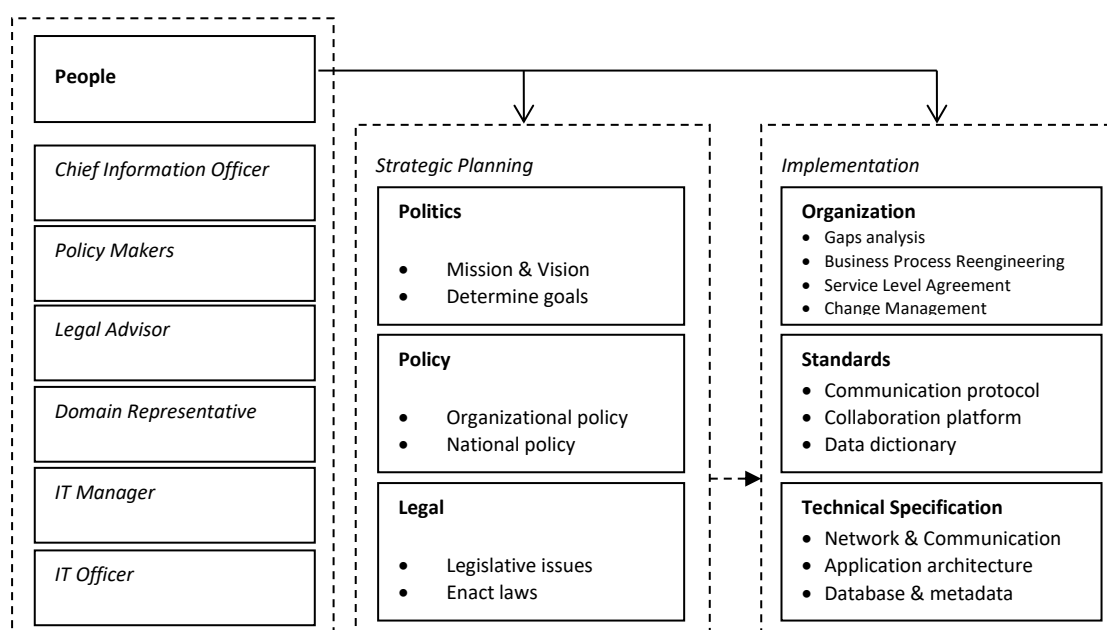


Figure 1: E-Government Systems Interoperability Model

VI. CONCLUSION

The paper has discussed the important factors towards achieving successful interoperability implementation in Government. These factors contribute towards the improvement of Government service delivery through integrated systems. Most governments are looking to develop integrated services that are tailor-made to citizen and business needs to increase process efficiency and data coordination across heterogeneous systems. This leads to business transformation and mutual benefits transferred from the stakeholders to the citizens.

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